# Testing scintillator counters and muon trigger for LArIAT

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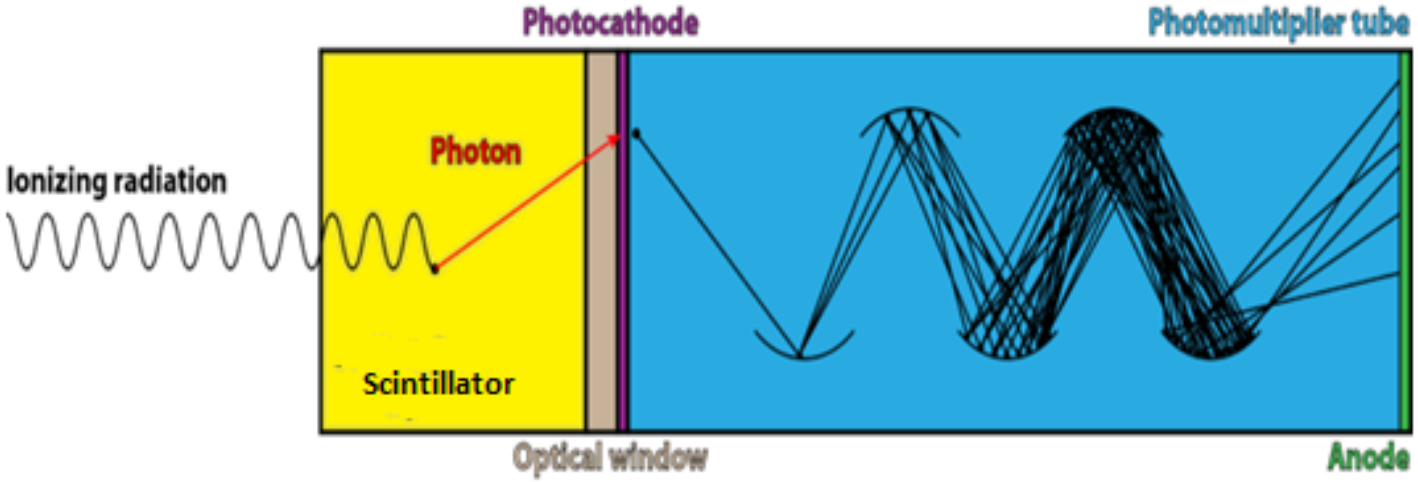
# Overview

- What are the scintillator counters?
- Different counters we used
- Electronics
- Finding Light leaks
- Different Tests (efficiency, noise, single count rate)
- Muon trigger
- Results

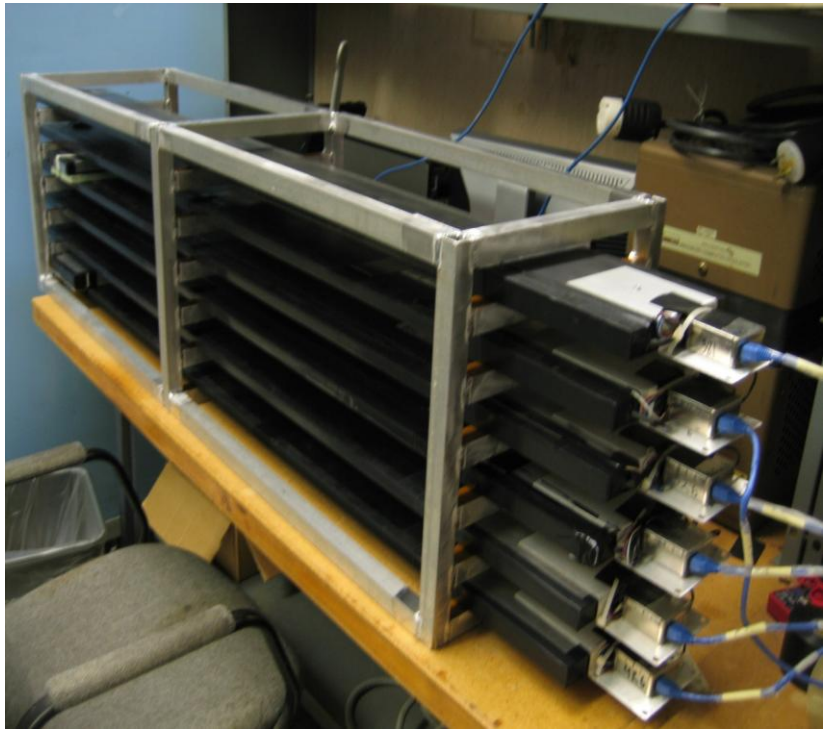
# Scintillator Counters




Plastic scintillator coupled with a PMT

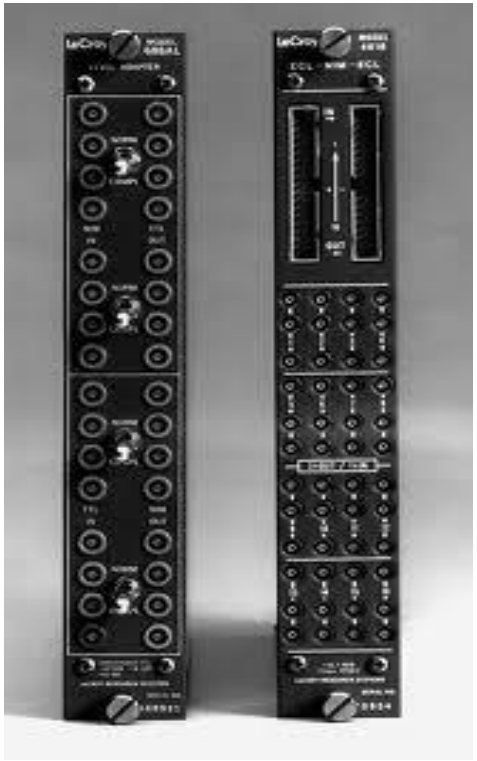
# Different Counters

**BSU Counters**



**TSU Counters**

# Nim Electronics



**NIM modules**

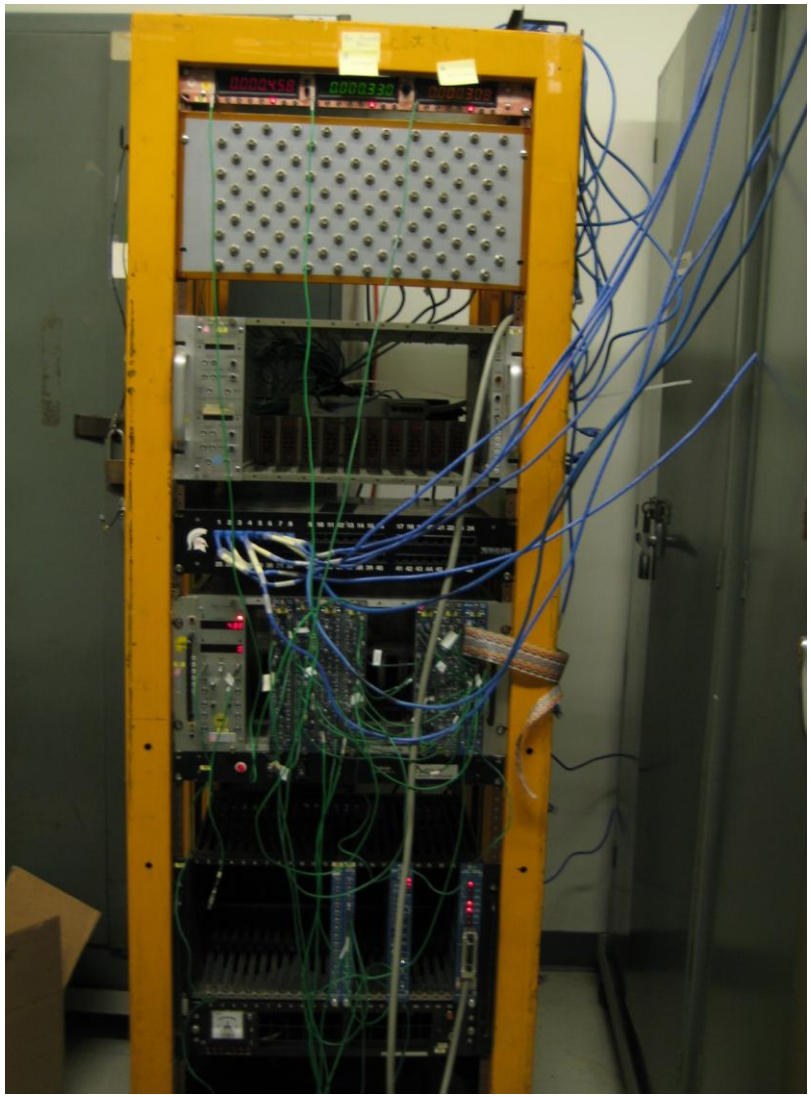
**NIM crate**

# CAMAC electronics


**CAMAC modules**


**CAMAC crate**

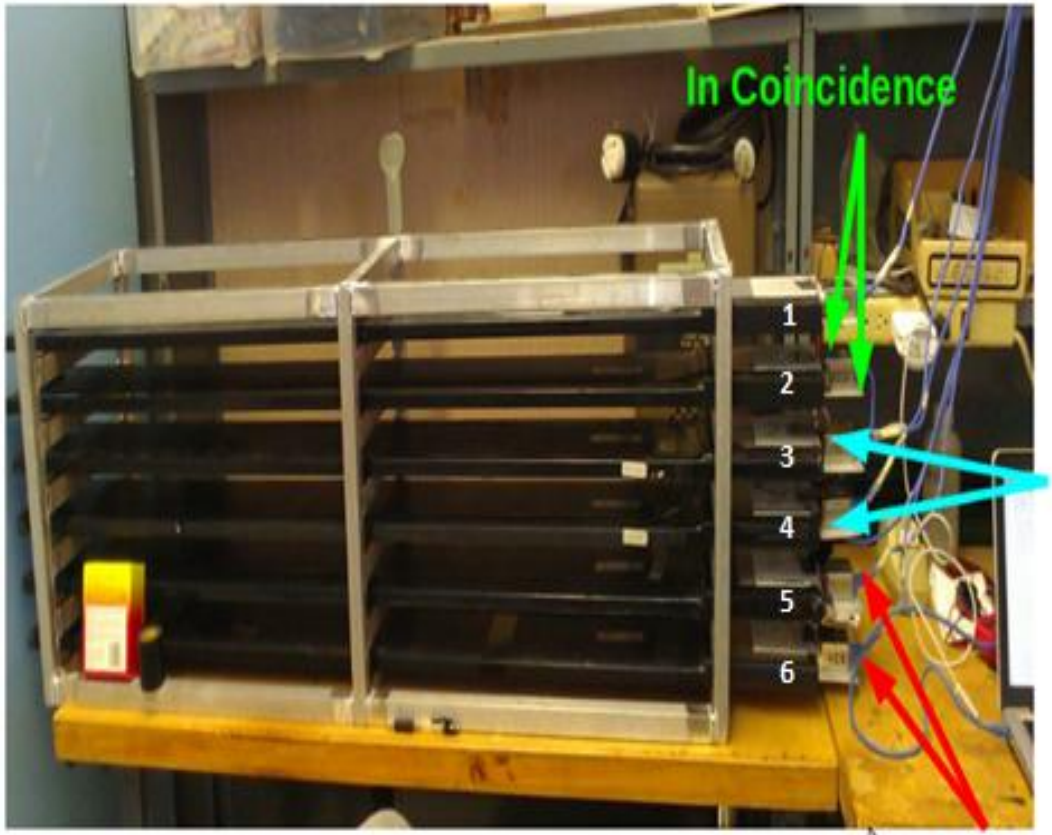
# Rack with the implemented logic



# Fixing Light Leaks

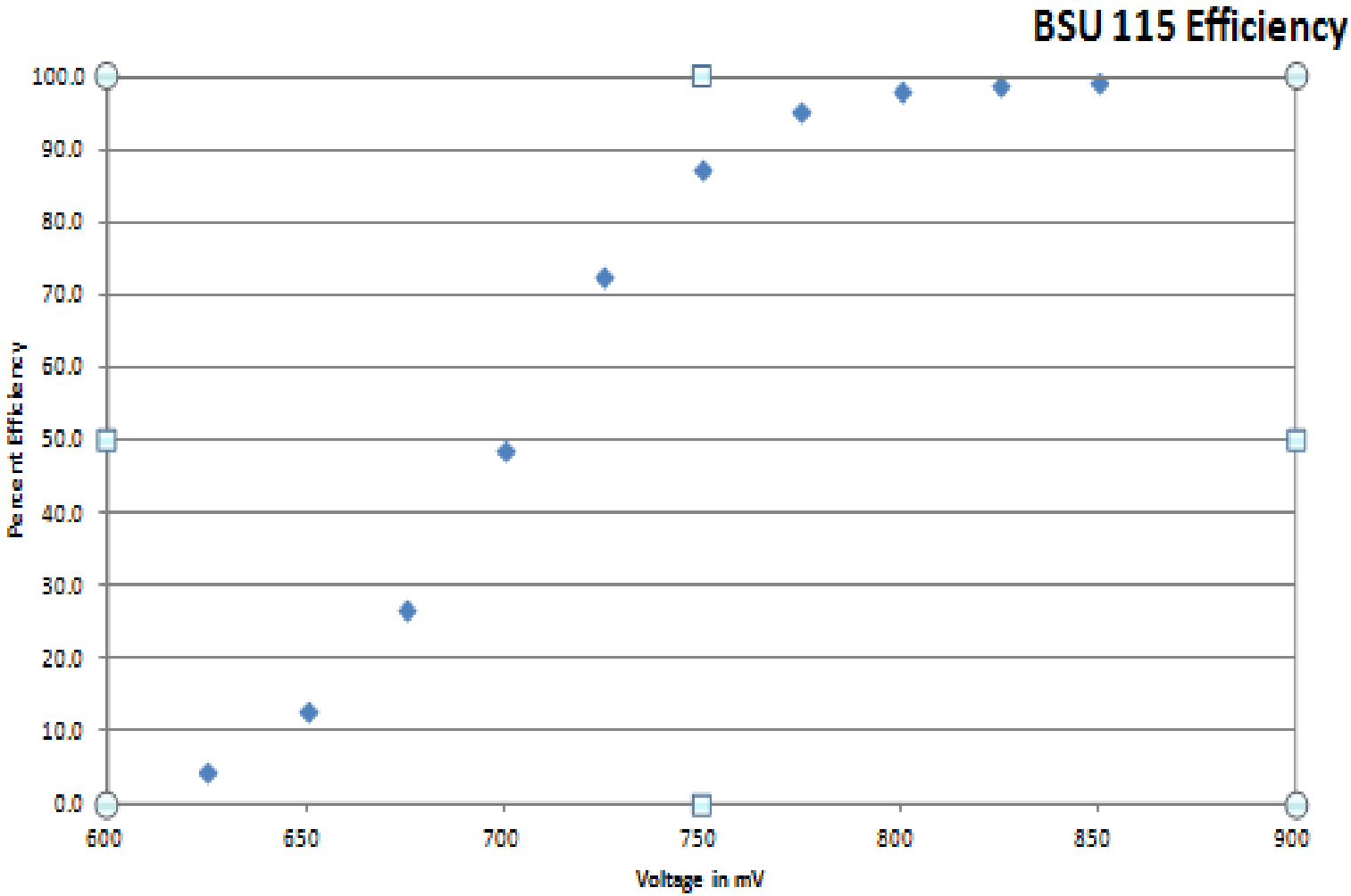
**A counter without light leaks must have the same single count rate with and without the black bag**.

# Efficiency test




$$\text{Efficiency}(3) = \frac{[(1 and 2) and (5 and 6)] and (3)}{(1 and 2) and (5 and 6)}$$

# General behavior of the efficiency



# Noise test

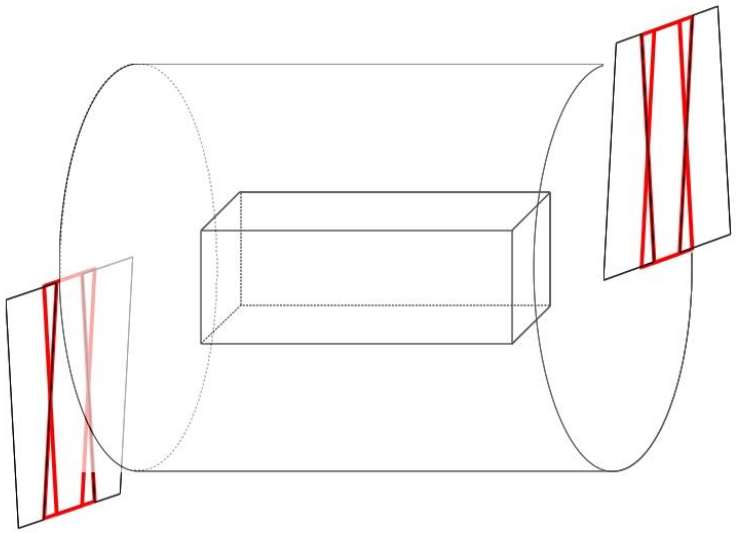
- We used the same configuration as in the efficiency test but we shifted the signal of the tested counters 5 microseconds.
- In this way we measured the number of random coincidences.
- We found practically zero counts for all the counters in 10 minutes of data acquisition.
- This value is consistent with what is expected for just random coincidences. We can thus be sure there is no additional noise from the PMTs.

# Choosing the operation voltages

- We want to be in the plateau region with a high efficiency (>95%)
- We don’t want a noisy counter.
- We don´t want a really high single count rate.

  ( we want a single count rate < 400 Hz for BSU and <200 Hz for TSU)

# Muon trigger



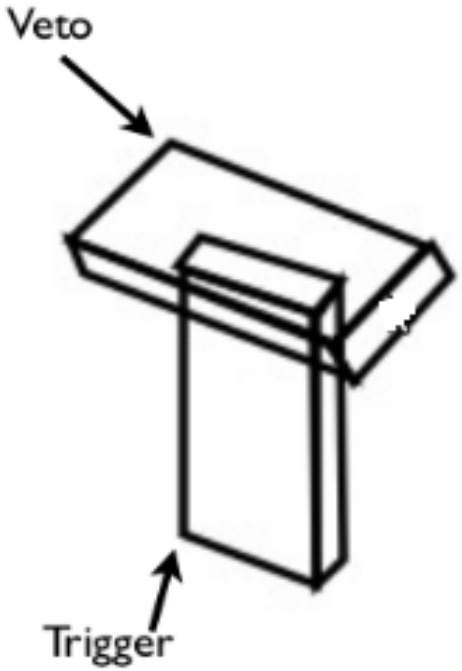
Here we can see a schematic of the TPC, the cryostat and one of the veto configurations for the muon trigger(in red) for LArIAT.

We tried several configurations for the veto and we chose the best one.

# Trigger/Veto configurations

We simulated a TPC by 4 TSU counters placed in between the triggers.

We searched for a Veto configuration that would allow us to maximize the ratio: $\frac{R_{trigger+TPC}}{R_{trigger}}$




Logic “or” between each pair of counters in the Veto configuration.

# Results

- We checked around 140 counters for light leaks.
- We found the optimal voltages of 80 BSU counters and 60 TSU counters.
- We found the muon trigger with the best veto configuration associated with it. We measured a trigger rate of 0.04 Hz in our system. This value is compatible with our estimate of the flux of cosmic muons through our system.